Low-current voltage tripler is inexpensive

Henry Yiu
Endevco, San Juan, CA

You can expand the low-cost ($2.25) voltage tripler of **Fig 1** by adding more stages, and you can lower the circuit's output impedance by adding more buffer inverters in parallel. To obtain a negative-voltage converter, simply reverse the diode and capacitor polarities and connect the V_{IN} terminal to ground. The circuit oscillates at approximately 350 kHz when R_{OSC}=1 kΩ and at approximately 4 kHz when R_{OSC}=100 kΩ. For the circuit as shown, **Fig 2** charts the efficiency and the load voltage vs load current. **EDN**

To Vote For This Design, Circle No 748

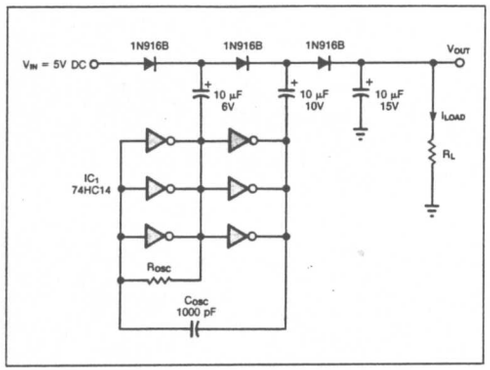

Fig 1—This circuit generates a 15V output by tripling V_{IN}.

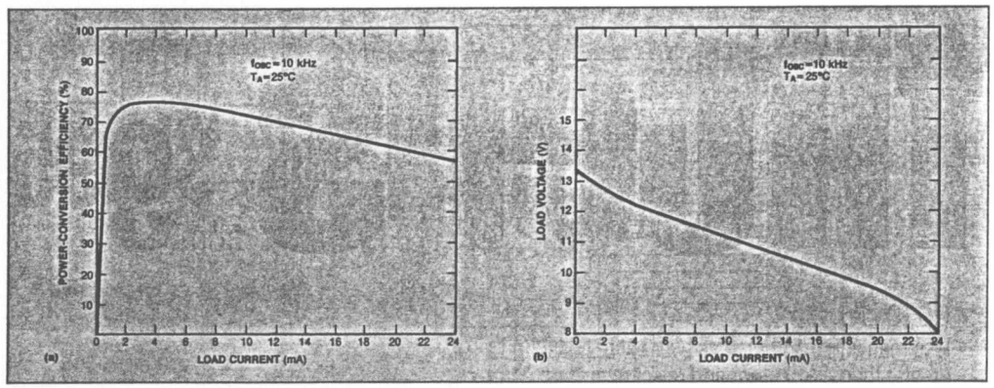

Fig 2—These curves show Fig 1's power-conversion efficiency (a) and load voltage (b) vs load current.

Precision load achieves 5-kV compliance

Dave Cuthbert
Hughes Aircraft Corp, Torrance, CA

Fig 1's circuit is a precision, 5- to 2000-µA constant-current load for 0- to 5-kV positive voltages. The load impedance is 250 GΩ shunted by 15 pF. If you connect a floating power supply to the output, the circuit becomes a current source with an output compliance as high as 5 kV.

The circuit's reference potential is the −30V supply. The R_1/R_2 divider lets you vary the voltage at IC_1's noninverting input over a 2V range (−30 to −28V) by adjusting R_2. In turn, the op amp drives MOSFET Q_1, which controls current through the sense resistor (R_3). Q_1's drain-to-source voltage determines the vacuum tube's cathode current by controlling the tube's grid-to-cathode voltage.

Because the control grid connects to R_3, the grid-emission current adds to the sensed cathode current. The screen current doesn't add to the cathode current because a 9V battery powers the screen grid. The normal screen current is about 20 µA, so an alkaline battery will last about a year. You should float the filament supply and operate the 6.3V ac filaments at 5V ac to provide better control of plate currents below 10 µA.

To achieve the 250-GΩ output resistance (indicated by a 20-nA change in plate current for a 5-kV change in V+), the tube's cathode must be well insulated from ground. Also, you should use a low-leakage transformer in the filament's floating-supply circuit and insulate the case of the screen-supply battery. **EDN**

To Vote For This Design, Circle No 749

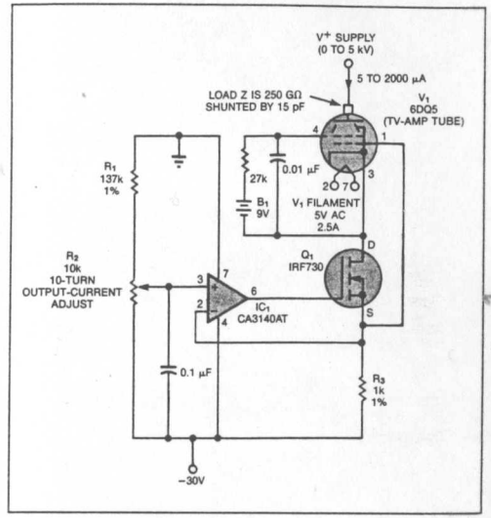

Fig 1—Using a vacuum tube to dissipate power, this constant-current load (or current source) has a 5-kV compliance voltage.

Op amp improves supply-voltage tracking

Jerry Fitzpatrick
Dytel Corp, Schaumburg, IL

In the regulated, bipolar power supply of **Fig 1**, an op amp causes the ±15V outputs to track one another regardless of load conditions. In many designs, feedback adjusts the output of a slave supply to mirror that of a stable master supply. The master can't compensate, however, for variations in the slave output caused by heavy, changing loads, and output tracking deteriorates as a result.

The op amp in **Fig 1** accomplishes bilateral tracking by monitoring both output-supply rails. You can apply this technique to various linear- and switching-regulator designs. When the outputs are equal, the op amp's output is zero and therefore has no effect on the circuit. This output becomes nonzero in response to load variations, opposing any tendency toward inequality between the two output voltages.

R_1 and R_2 set the output-voltage magnitudes; you can add a small voltage-adjustment potentiometer in series with one of these resistors. The output-voltage accuracy depends directly on the matching between the sense resistors (R_4 and R_5). Only the op amp's slew rate limits the circuit's response to load transients; if you desire a slower response, add a capacitor across the feedback resistor (R_3). Finally, note that you should provide electronic shut-down circuitry or a fuse to protect the circuit against output short circuits. **EDN**

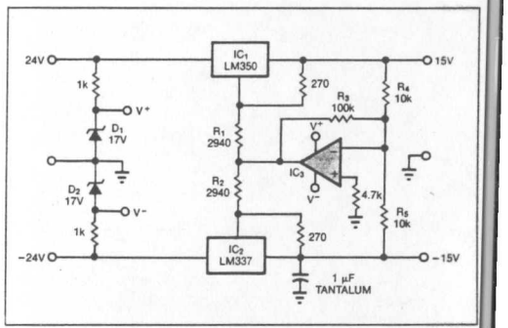

Fig 1—This regulated, bipolar supply maintains equal-valued outputs that track despite output-load variations.

To Vote For This Design, Circle No 750